Spectrally resolved reflected SW, >20 years apart

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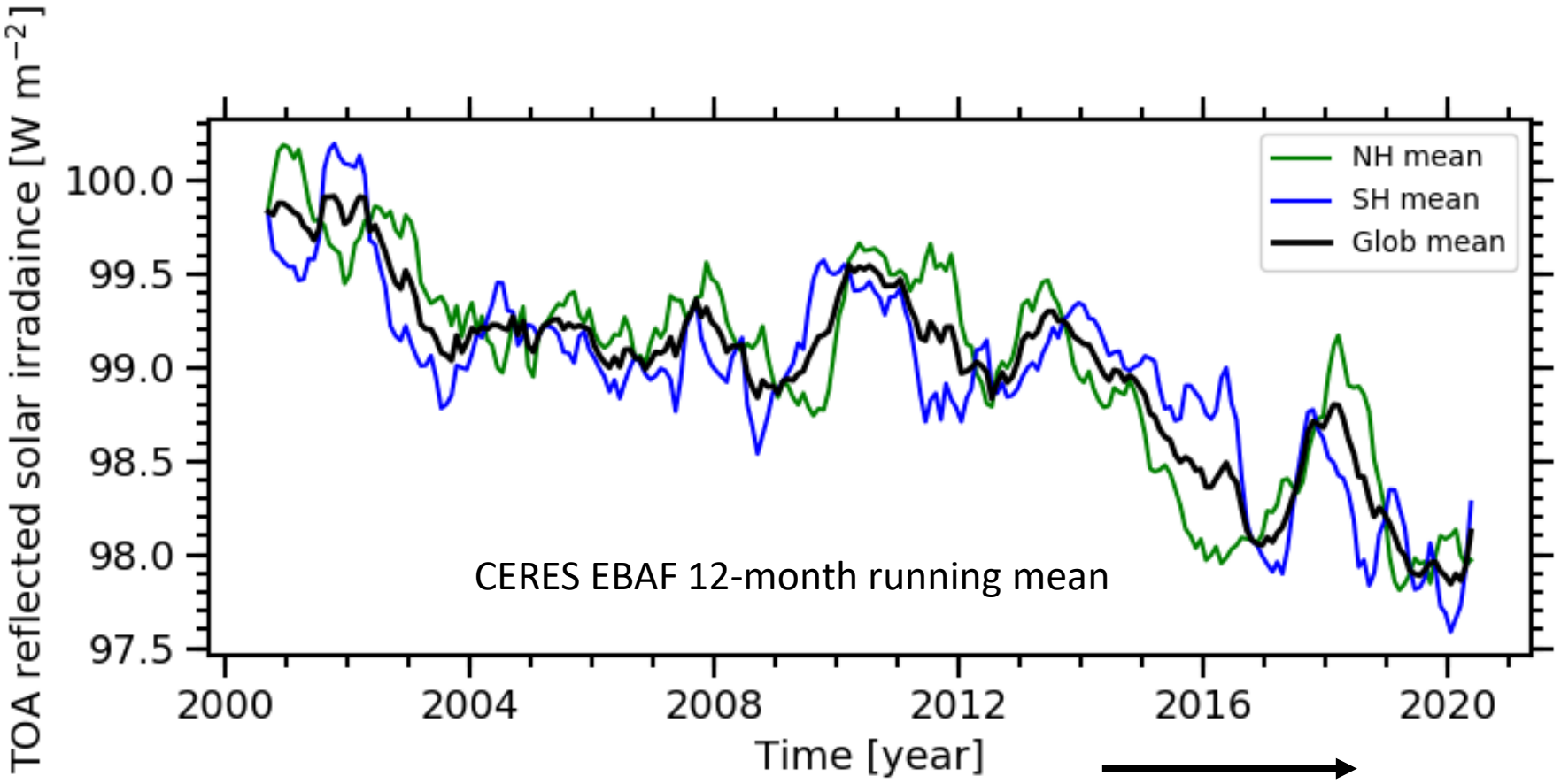

Primarily decreases in low cloud cover?

Loeb et al., 2018; 2021

Spectrally resolved reflected SW, >20 years apart

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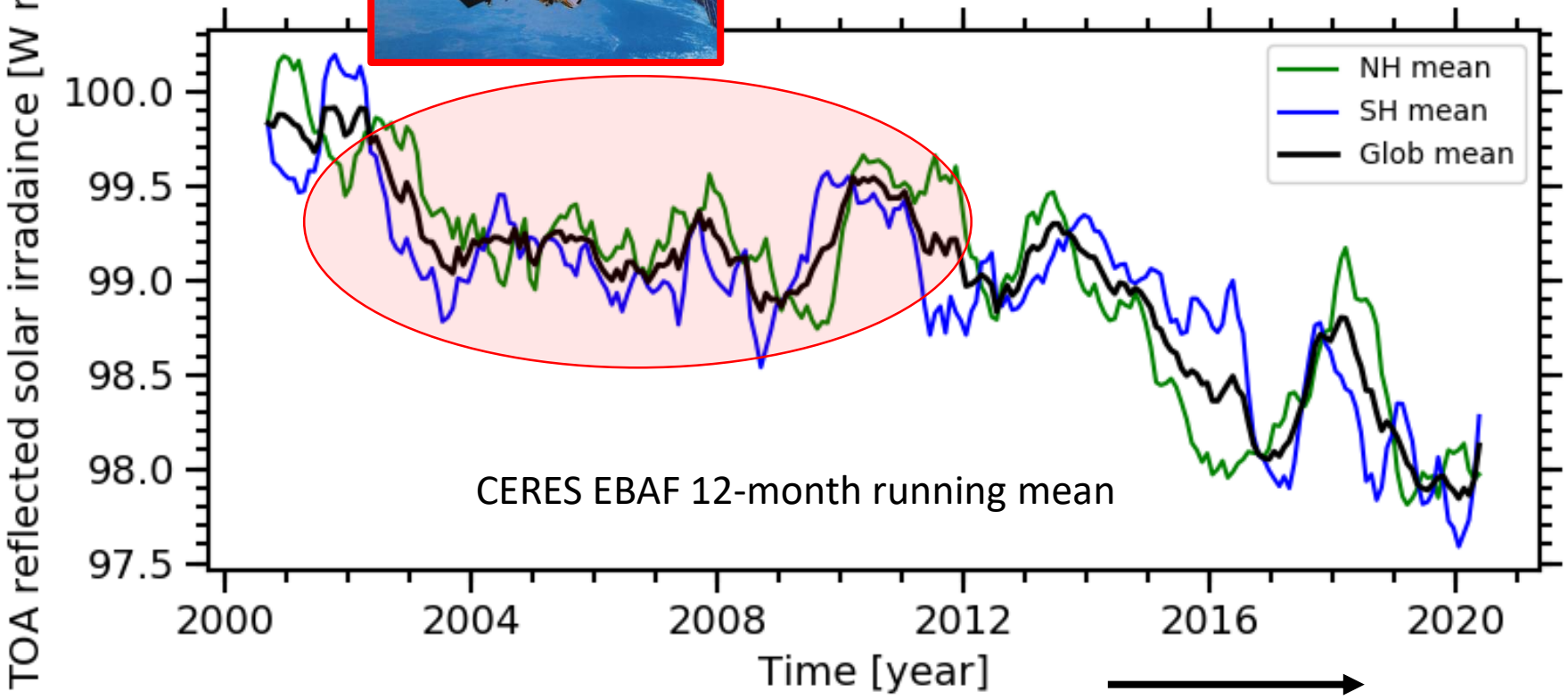
SCIAMACHY

- ENVISAT
- 2002–2012
- 214–2386 nm
- 0.2–1.5 nm sampling



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CLARREO Pathfinder/HySICS

- ISS
- 2023–?
- 350–2300 nm
- 3 nm sampling

Primarily decreases in low cloud cover?

Loeb et al., 2018; 2021

Immediate concerns of SCIA-CPF comparison

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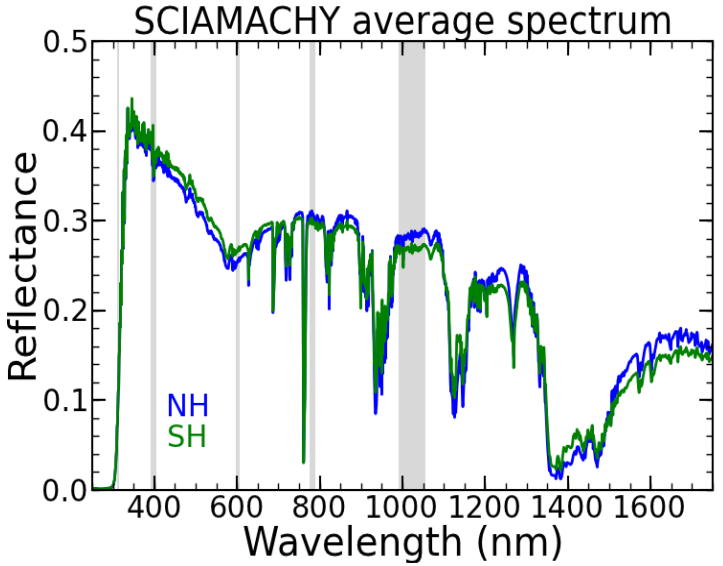
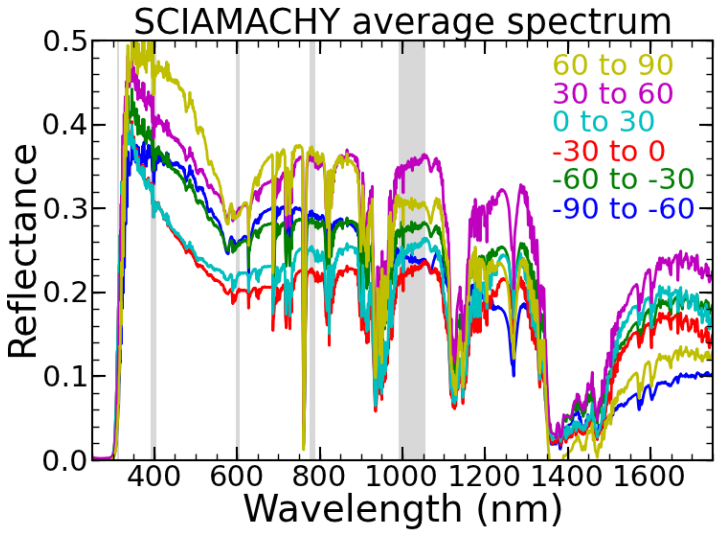
Concern	Possible counter-argument
SCIAMACHY observation quality	• Comparisons in reflectance • Wavelengths < ~1700 nm
Will changes be large enough to detect?	• 1–2 % change in large-scale broadband SW • Spectral changes are larger – no broadband compensation of processes! • Regional and local changes are even larger
Sampling differences (global/diurnal coverage, footprint size, scan angle)	• Nadir only? • Average to coarsest spatial resolution? • Set “co-location” criteria?



Spectral hemispheric asymmetry
See Stephens et al., 2015



Larger regional spectral differences

Attribution: frequency of spectral signatures

Jake Gristey
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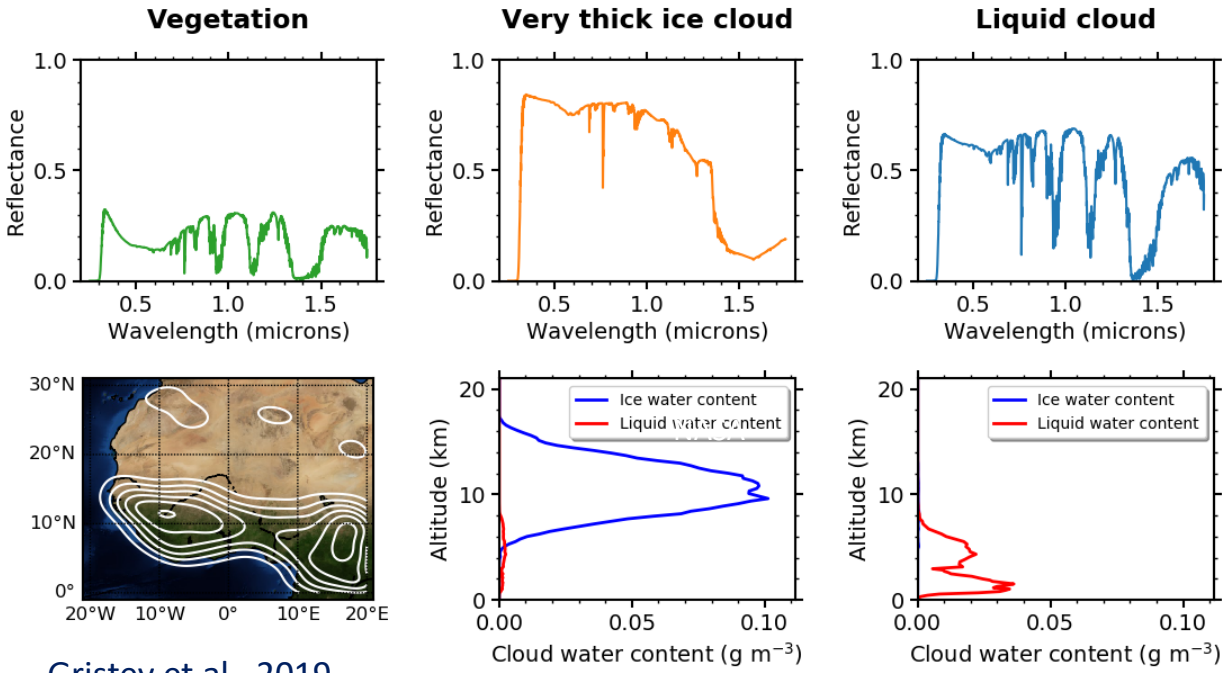
- Observationally-based profiles
  - CERES–CALIPSO–CloudSat–MODIS (C3M)
  - West Africa (20W–20E and 0–30N)
  - ~100,000 profiles

Kato et al., 2010 & 2011;
Bodas-Salcedo et al., 2016

- Simulate spectra and cluster
  - 10 clusters separate data well
  - Each cluster is associated with distinct properties of the underlying system



Gristey et al., 2019

Attribution: frequency of spectral signatures

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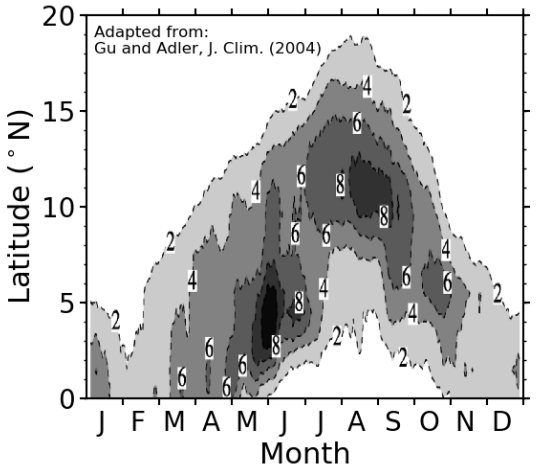

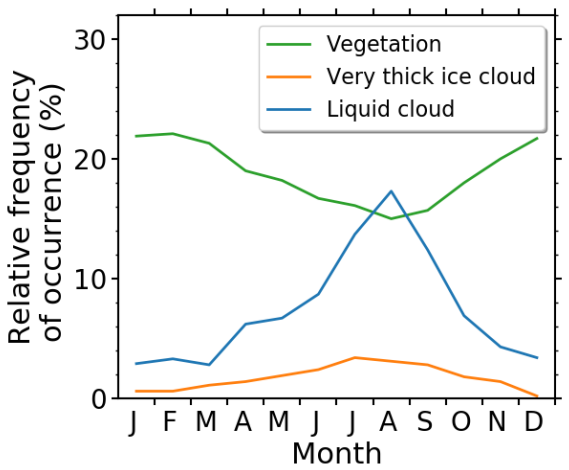

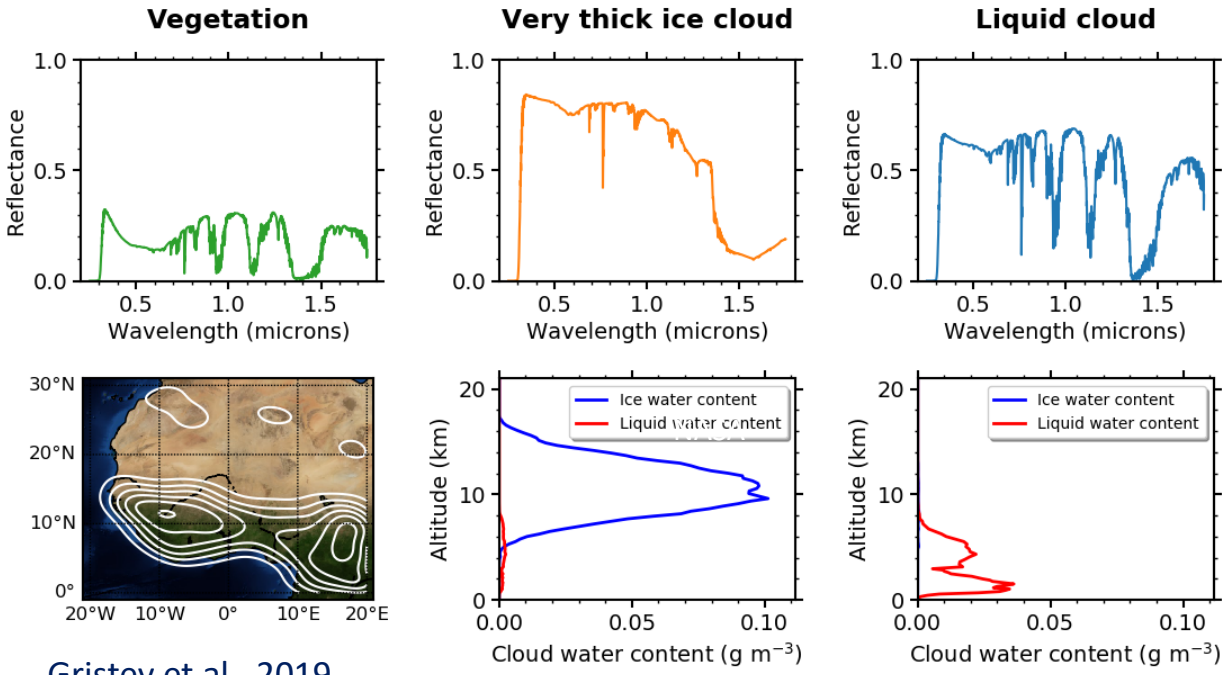

Gristey et al., 2019

- "Assign" real observed spectra to simulated spectral signatures
  - Follows West African Monsoon very closely

Attribution: frequency of spectral signatures

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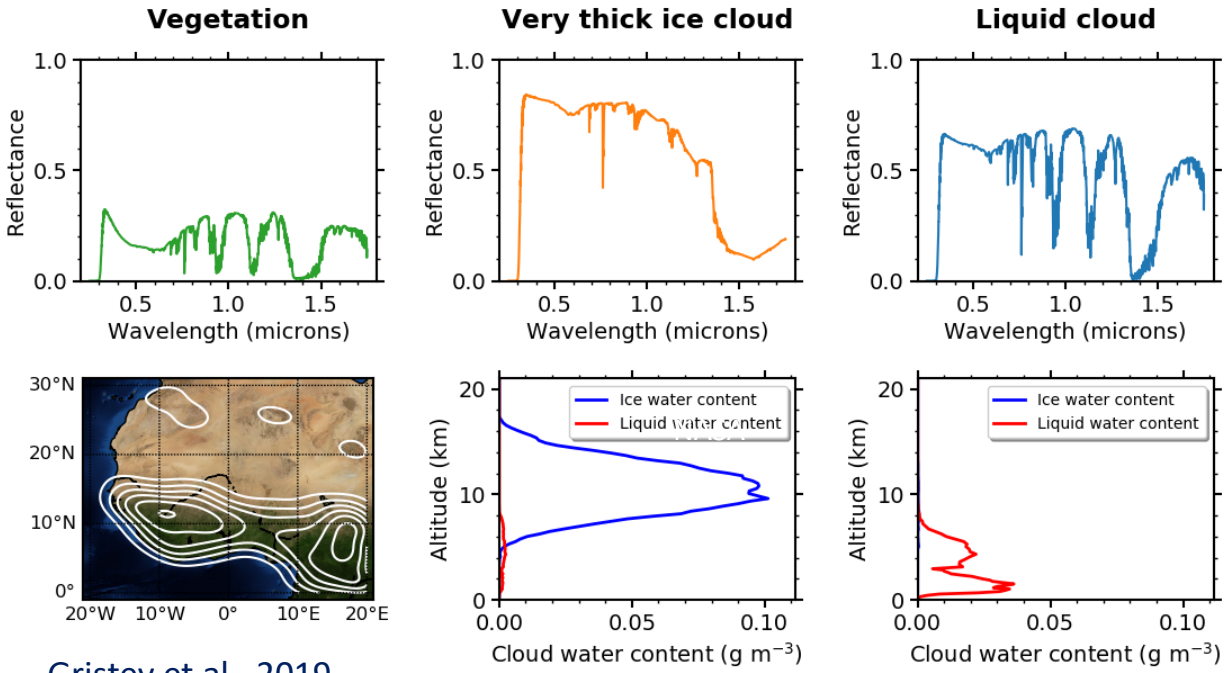

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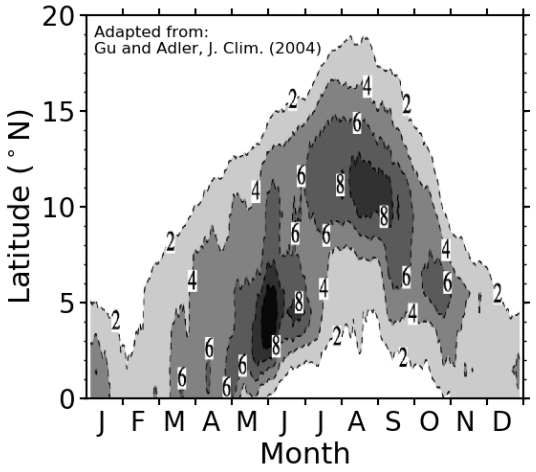

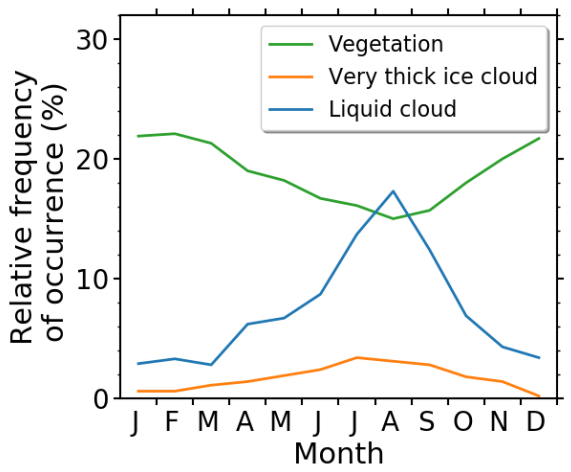

- "Assign" real observed spectra to simulated spectral signatures
  - Follows West African Monsoon very closely

Assign SCIA and CPF spectra to known spectral signatures, and examine how the relative frequency of occurrence has changed.

Extra

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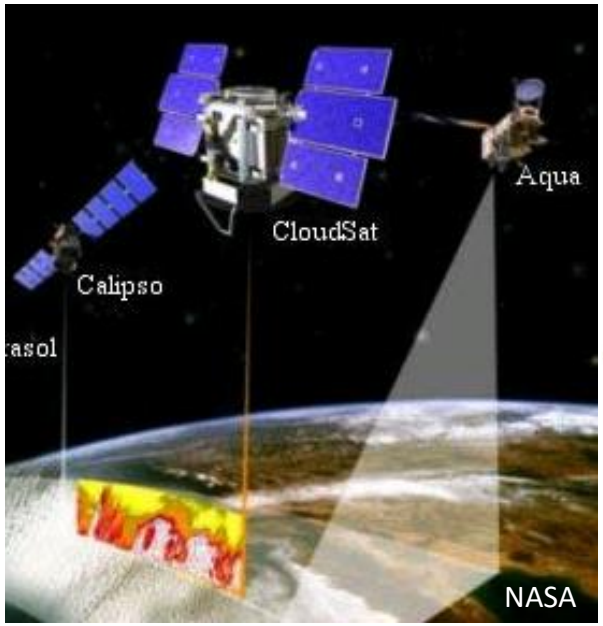
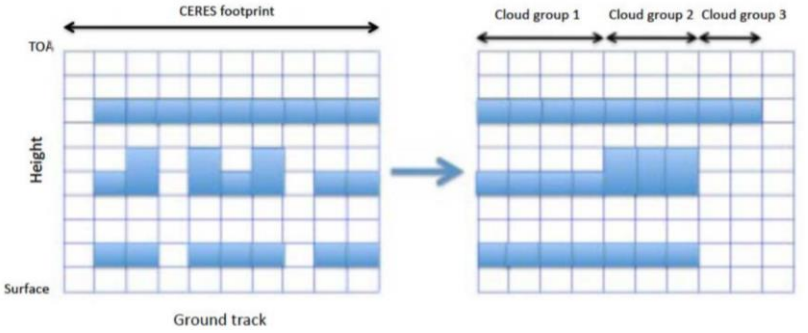
- CERES–CALIPSO–CloudSat–MODIS (CCCM) product
  - Up to 16 “cloud groups” in each CERES footprint
  - Vertical profiles of cloud (liquid and ice), aerosol (7 types) and surface reflectance
  - Other profiles (temperature, water vapor, ozone) added from GEOS

Kato et al., JGR, 2010 & 2011;
Bodas-Salcedo et al., J. Clim., 2016





Kato et al., CCCM variable descriptions, 2014

- West Africa (20W–20E and 0–30N) in 2010
  - Diverse variety of surface types
  - Active West African monsoon season for diverse cloud regimes
  - 90,917 scenes

Extra

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